inferior and superior borders of the lateral meniscus moved 0.82 mm superiorly (R^2=0.56, P < 0.001) and 1.01 mm inferiorly (R^2=0.33, P = 0.013) respectively. The lateral anterior horn moved 4.2 mm posteriorly on the tibia (P < 0.001) and widened by 1.6 mm (P < 0.001). The posterior horn's posterior and anterior borders moved 2.4 mm (R^2=0.67, P < 0.001) and 3.9 mm (R^2=0.65, P < 0.001) posteriorly respectively. The medial anterior horn widened by 2.3 mm posteriorly (R^2=0.3, P = 0.005) and the posterior horn narrowed by 1.5 mm (R^2=0.22, P = 0.022).

Conclusions: Weight bearing causes the lateral meniscus to increase in height and its posterior horn to widen. The medial meniscus moves posteriorly with the posterior horn and body widening and the internal diameter decreasing.

As the knee flexes, the tibia internally rotates on the femur, the lateral meniscus is squashed and moves posteriorly on the tibia with a decrease in the internal diameter. The medial anterior horn widens and the posterior horn narrows with flexion. Better understanding meniscal adaptation to weight bearing and flexion may improve our understanding of meniscal tears and the development of osteoarthritis.

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THE RELEVANCE OF METABOLIC CRUCIATE LIGAMENT CHANGES TO KNEE OSTEOARTHRITIS

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Purpose: Increased magnetic resonance imaging (MRI) signal within the anterior cruciate ligament is often interpreted as attenuation, questionable tear, or tear. Musculoskeletal radiologists recognize that in the absence of a knee injury these are more likely "degenerative" changes. In our review of MRI for knee osteoarthritis (OA) we noted increased bone signal and cysts in T2 weighted images at insertion sites for both the both the anterior and posterior cruciate ligaments.

In rabbits the concentration of the reducible ACL collagen crosslinks is significantly greater in the younger tissues than aged tissues. The overall effect on the development of degenerative joint disease is not clear. The Whole-Organ Magnetic Resonance Imaging Score (WORMS) does not look at ACL changes other than presence or absence. MRI findings mistaken for tears show a greater girth than normal and increased signal on all sequences. The majority had intact and normal appearing ligaments at arthroscopy. MRIs done in 19 cadavers, ages 55–88, mean 74, revealed some ligaments with more signal. These had fibers that were more divergent and areas of mucoid degeneration with eosinophilic degeneration. In a series of 4,221 knee MRIs there were 74 cases that met imaging criteria. 56 (76%) had discrete intraligamentous ganglia, 18 (24%) mucoid degeneration, and 26 (35%) features of both. Of 52 patients with accessible records, 48 had no clinical evidence of instability. Twelve patients who underwent arthroscopy had an intact anterior cruciate ligament at that time.

Reports of clinical improvement with arthroscopy are uncommon but those cases show diffuse hypertrophy with a yellowish homogenous mass on the femoral insertion of the ACL.

The purpose of this study was to see if there were other MRI changes seen in OA who had bone changes associated with ACL or PCL signal increase.

Methods: This was an IRB approved retrospective study reviewing 53 patients with degenerative knee OA and MRIs revealing ACL changes. Demographic data included height, weight, body mass index (BMI), age, race, and sex. MR images were scored for ACL or PCL "edema", diffuse increased T2 bone signal and/or bone cysts at ligament insertion sites, subchondral bone "edema", and meniscal degeneration and extrusion.

Results: There were 57 knee MRIs in 53 patients. The four bilateral knees had ACL related changes on both sides. ACL edema predominated over the PCL. 50 of 57 knees had ACL changes (one ACL was clearly absent) and 17 had PCL changes. 13 Of the 17 knees with PCL change also had ACL changes. ACL insertion site T2 bone signal was seen in 20 and 8 in the femur. PCL insertion site T2 bone signal was seen in 20 and 8 in the femur. ACL insertion site ganglions were seen in 35 tibias and in 7 femurs. Only one had no evidence of an ACL change. PCL insertion site ganglions were seen in 6 tibias and no femurs. Two had no obvious PCL change. Medial meniscal degeneration was commonly associated with meniscal extrusion and was present in 30 of the ACL ligament changes (most commonly posterior horn) with only two without the ACL changes. Medical bone edema was seen in 17 cases and all but one had ACL changes. The one case had an absent ACL with PCL changes.

Conclusions: The WORMS score only accounts for a presence of an abnormality in the ACL. We are not aware of any effort to correlate cruciate ligament change with other MRI findings seen in knee OA. The biological consequences of the cross talk between ligaments and bone may be important in understanding the function of the knee as an organ and the changes that in OA as a function of the knee as an organ in failure. Future treatment management will likely be enhanced by this understanding.

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PRECISION OF QCT OF THE KNEE

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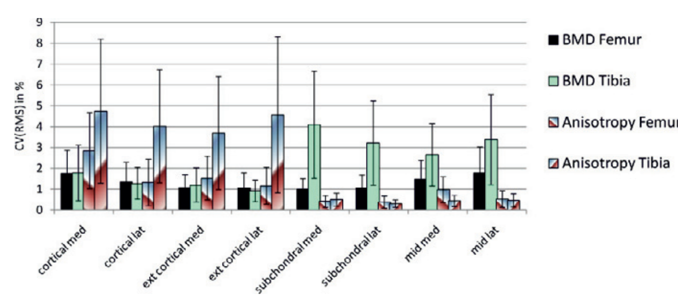
Purpose: Besides cartilage, subchondral bone plays a major role in the etiology and pathogenesis of osteoarthritis. A new QCT approach has been developed to quantify BMD in various subchondral volumes of interest. Here, precision was evaluated using double measurements of 20 cadaveric knees.

Methods: The QCT application used the following acquisition protocol: 120 kV, 212 mAs, slice thickness 0.5 mm, scan range 50 cm including distal femur and proximal tibia, reconstruction increment 0.3 mm, field of view 13 cm. In order to calculate BMD from the measured HU values an in scan calibration phantom was used. Image analysis consisted of automatic 3D periosteal and endosteal segmentation of the tibia and femur, segmentation of the growth plates and determination of anatomic coordinates systems relative to which the following analysis VOIs were placed at different distances from the joint gap: cortical, extended cortical, subchondral epiphyseal and mid-epiphyseal. Each of these VOIs was further divided into a medial and a lateral part. For each VOI BMD, BMC and volume, as well as parameters characterizing the trabecular bone structure such as the anisotropy were determined. In order to evaluate the precision of the technique, 20 cadaveric human knees (6 females mean age 85 years, 4 males mean age 81 years) were scanned twice with repositioning on a Siemens SOMATOM Sensation 64 scanner.

Results: Detailed precision values (Root mean square coefficients of variation (CV(RMS)) are shown in the diagram for BMD and anisotropy. In the femur BMD precision was excellent for all VOIs.



The tibia BMD precision was higher in the subchondral epiphyseal and mid-epiphyseal VOIs reflecting a more difficult segmentation in the tibia due to a thinner cortex and a less distinct growth plate which affects the precision of the non-cortical VOIs. Precision errors for anisotropy were below 5% with smaller values again in the femur. The relatively high precision errors for anisotropy in the cortical VOIs of the tibia indicate that grey values do not show a preferred directional pattern in these VOIs.

Conclusions: QCT of the knee may be a promising method to complement x-ray film and MRI as imaging techniques in OA. With QCT subchondral bone density and bone structure may be characterized. Initial precision results show low BMD errors and moderate errors for anisotropy in cortical VOIs. However the main value of structural assessments is probably in the trabecular subchondral bone were precision errors were also excellent. In vivo data of humans are easier to segment but may come with additional movement artifacts so that we expect similar or smaller precision errors in humans in vivo.